IDENTIFYING AIRLINE PASSENGER SATISFACTION USING MACHINE LEARNING

Date	9 November 2023
Team ID	Team-592320
Project Name	Identifying Airline Passenger Satisfaction using Machine Learning

Project Report

Content

1)INTRODUCTION

1.1 Project Overview

The project "Identifying Airline Passenger Satisfaction using Machine Learning" aims to leverage machine learning techniques to analyse and predict passenger satisfaction with airline services. The project involves collecting and utilizing various features or factors that may influence passenger satisfaction during air travel.

The ultimate goal of the project is to develop a predictive model that can effectively identify factors influencing passenger satisfaction and make predictions based on new data. This information can be valuable for airlines to enhance customer experience and improve overall satisfaction levels.

1.2 Purpose: Airline Passenger's Satisfaction

The purpose of a project focused on airline passengers' satisfaction is typically to enhance and optimize the overall travel experience for airline customers. The specific objectives include:

Improving Customer Experience:

Identify and address pain points in the passenger journey to make it more enjoyable and stress-free.

Increasing Loyalty:

Enhance customer loyalty and retention by exceeding expectations and building positive associations with the airline brand.

Competitive Advantage:

Stand out in a competitive market by offering superior customer service and satisfaction compared to other airlines.

Operational Efficiency:

Streamline processes such as booking, check-in, and baggage handling to minimize delays and enhance overall efficiency.

Brand Image:

Build a positive brand image by consistently delivering high levels of customer satisfaction, leading to positive word-of-mouth and reviews.

Data-Driven Decision-Making:

Utilize passenger feedback and data to make informed decisions on service improvements and innovations.

Customer Retention:

Focus on retaining existing customers by meeting and exceeding their expectations, reducing the likelihood of them switching to other airlines.

Financial Performance:

Increased customer satisfaction can positively impact financial performance through repeat business and positive recommendations.

Regulatory Compliance:

Ensure compliance with aviation regulations and standards related to passenger experience and safety.

Employee Satisfaction:

Recognize the role of airline staff in passenger satisfaction and implement measures to enhance employee morale and performance.

In essence, the project aims to create a positive and memorable experience for airline passengers, fostering loyalty, attracting new customers, and ultimately contributing to the success and growth of the airline.

2)LITERATURE SURVEY

2.1 Existing Problem

Introduction

Airline passenger satisfaction is a crucial aspect of the aviation industry. As the competitive landscape of the airline industry continues to evolve, airlines worldwide are increasingly focusing on providing exceptional passenger experiences. Understanding the factors that influence passenger satisfaction and the strategies employed to enhance it is vital for airlines striving to maintain a loyal customer base and remain profitable. This literature review synthesises the key findings from existing research on airline passenger satisfaction, highlighting the factors influencing it and the measures taken by airlines to improve the passenger experience.

1. Determinants of Passenger Satisfaction

Numerous studies have identified various determinants of passenger satisfaction within the airline industry. Key factors include:

1.1. Service Quality: Parasuraman et al. (1988) introduced the SERVQUAL model, which assesses service quality based on five dimensions: reliability, assurance, tangibles, empathy, and responsiveness. Research has consistently shown that higher service quality leads to greater passenger satisfaction (O'Connell and Williams, 2016).

1.2. On-Time Performance: Punctuality, often measured by on-time departure and arrival, is a significant driver of passenger satisfaction (Wittman, 2012). Delays and disruptions can have a negative impact on overall passenger experiences.

1.3. Cabin Comfort and In-Flight Amenities: Comfortable seating, in-flight entertainment, and other amenities significantly affect passenger satisfaction (Kim et al., 2018). Airlines invest in cabin upgrades to enhance passenger comfort.

2. The Role of Technology and Digital Services

In the digital age, technology has played a transformative role in shaping passenger satisfaction:

2.1. Online Booking and Mobile Apps: The convenience of booking flights online and utilizing mobile apps for check-in, updates, and other services has become a primary driver of satisfaction (Hildebrandt et al., 2020).

2.2. In-Flight Connectivity: Access to Wi-Fi and the ability to stay connected during flights has become increasingly important (Schwarz et al., 2017). Airlines are investing in onboard connectivity solutions.

3. Customer Engagement and Loyalty Programs

Airlines recognize the importance of building and maintaining customer loyalty:

3.1. Frequent Flyer Programs: Research by Lee and Lee (2018) indicates that passengers who are members of frequent flyer programs are more likely to be satisfied and loyal to an airline. These programs offer rewards and incentives to retain customers.

3.2. Customer Feedback and Service Recovery: The way airlines handle customer feedback and address service issues can significantly impact passenger satisfaction. Proactive service recovery measures can mitigate dissatisfaction (McCole et al., 2010).

4*. Cross-Cultural and Demographic Differences*

Studies have highlighted that passenger satisfaction may vary across cultures and demographics:

4.1. Cultural Differences: Cultural factors can influence passenger expectations and perceptions of airline service quality (Chow and Kuo, 2017).

4.2. Demographic Variation: Passengers of different age groups or travel purposes (e.g., business vs. leisure) may have varying satisfaction levels and priorities (Duncan and Papp, 2019).

5. Environmental Considerations

With increasing awareness of environmental issues, sustainability and eco-friendly practices are gaining importance in passenger satisfaction:

5.1. Eco-Friendly Initiatives: Airlines that invest in eco-friendly practices, such as reduced carbon emissions and sustainable operations, are often viewed more positively by passengers (Gössling et al., 2021).

Conclusion:

Airline passenger satisfaction is a multifaceted concept influenced by a variety of factors, including service quality, technology, loyalty programs, and environmental considerations. Understanding these determinants and actively seeking to improve them is essential for airlines to meet the ever-changing demands of passengers and maintain a competitive edge in the industry. Future research in this field should continue to explore emerging trends and evolving passenger preferences, ensuring that airlines can adapt and respond effectively.

2.2 References

O'Connell and Williams, 2016

https://www.researchgate.net/publication/222701060_Passengers'_perceptions_of_low_cost_airlines_and_full_service_carriers_A_case_study_involving_Ryan air_Aer_Lingus_Air_Asia_and_Malaysia_Airlines

Wittman, 2012:

https://www.sciencedirect.com/science/article/pii/S0969699713001385

Kim et al., 2018:

https://www.researchgate.net/profile/Hak-Seon-Kim/publication/336240340_The_Text_Mining_Approach_to_Understand_Seat_Comfort_Experience_of_Air_Passengers_through_Online_Review/links/5d961c31a6fdccfd0e7434fd/The-Text-Mining-Approach-to-Understand-Seat-Comfort-Experience-of-Air-Passengers-through-Online-Review.pdf

(Schwarz et al., 2017)

https://www.researchgate.net/profile/Abdul-Nasir-27/publication/318716039_Operational_performance_and_financial_performance_of_Malaysia_Airlines/links/6289cfa339fa217031652875/Operational-performance-and-financial-performance-of-Malaysia-Airlines.pdf

Research by Lee and Lee (2018)

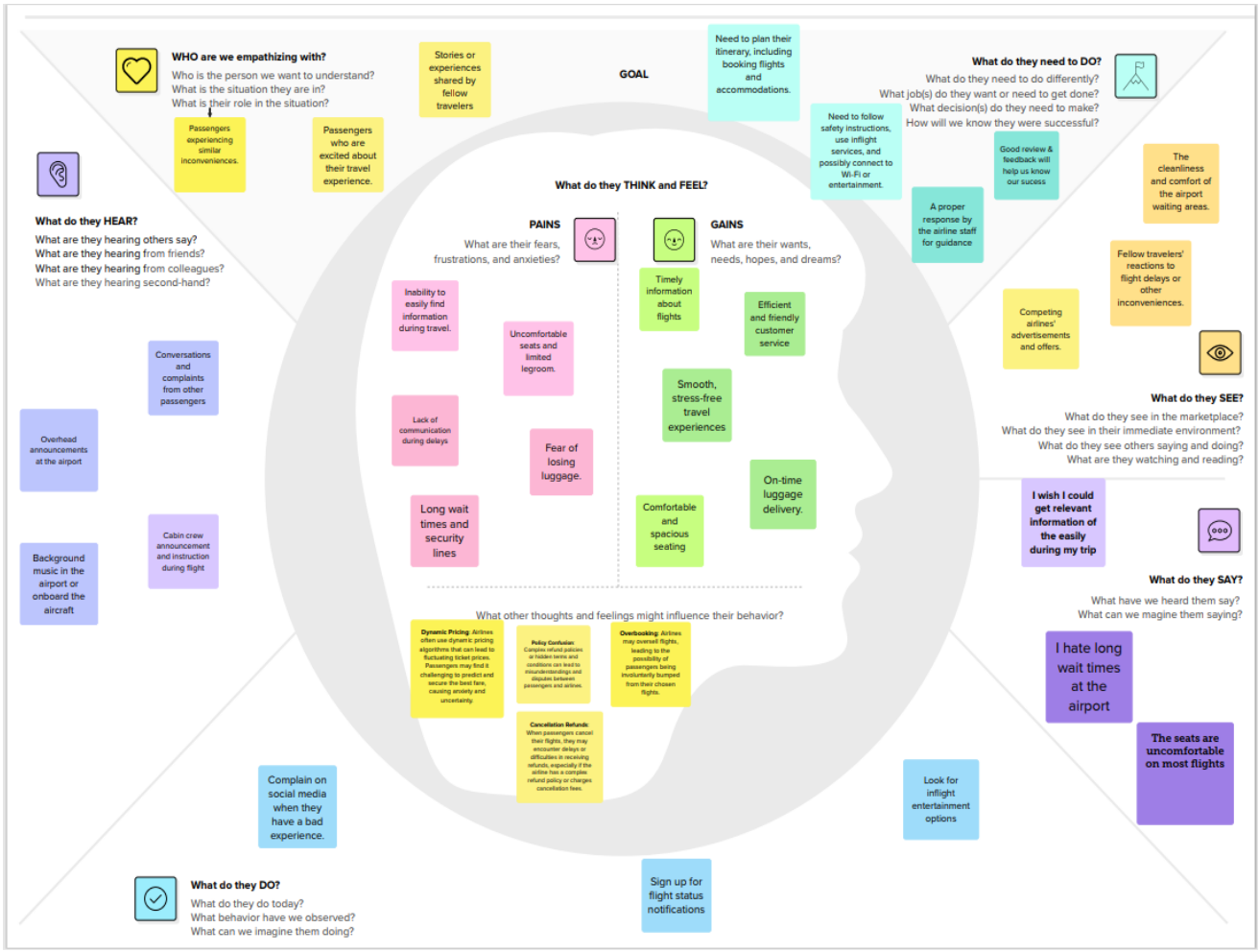
https://www.proquest.com/openview/759fbdc9a2931c1480f04595f13e25cb/1?pq-origsite=gscholar&cbl=2030191

2.3 Problem Statement Definition

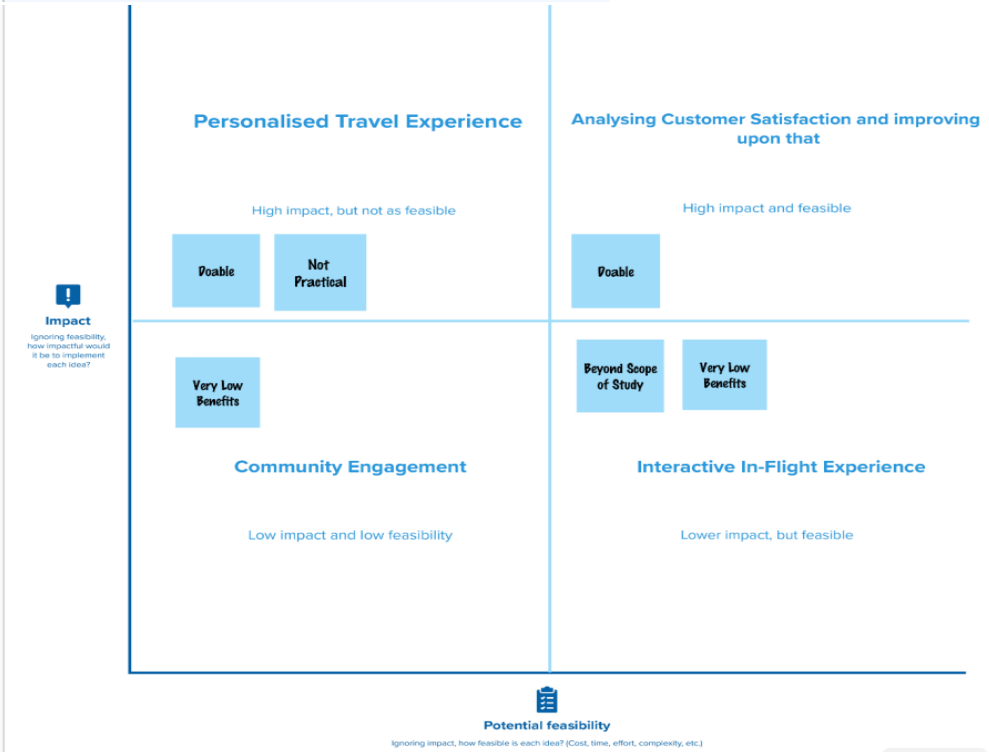
Airline passenger satisfaction is critical to the success of the airline industry. However, accurately measuring and understanding passenger satisfaction can be challenging due to the complex and multifaceted nature of the flying experience. Traditional survey methods are often time-consuming and may not capture real-time feedback. Airlines need an efficient and predictive solution to understand and enhance passenger satisfaction.

3)IDEATION & PROPOSED SOLUTION

3.1Empathy Map Canvas



3.2Ideation & Brainstorming



4)REQUIRMENT ANALYSIS

4.1 Functional Requirements

Data Collection and Preprocessing:

Define the sources of data for passenger satisfaction analysis (e.g., surveys, online reviews, social media, flight records).

Specify the data preprocessing steps, such as cleaning, normalization, and feature extraction.

Feature Selection:

Define the relevant features that will be used to predict passenger satisfaction (e.g., flight duration, in-flight services, seat comfort).

Specify how feature engineering will be conducted, if necessary.

Model Deployment:

Define the machine learning algorithms to be used (e.g., logistic regression, decision trees, neural networks)

Specify how the models will be trained and evaluated.

Define the evaluation metrics (e.g., accuracy, F1-score) for model performance.

User Interface:

Describe the user interface or dashboard for end-users to input data and view predictions

Specify the design and usability requirements of the interface

Integration:

Specify how the machine learning model will be integrated into the airline's systems (e.g., booking websites or customer service tools).

Deployment:

Define the deployment process, including server requirements and hosting solutions.

Specify how often the model will be updated and retrained.

Testing:

Define the test cases and scenarios to ensure the accuracy and reliability of the model.

Specify how testing data will be collected and used.

4.2 Non-Functional Requirements

Performance:

Specify the expected response time for the system when making predictions.

Define the system's scalability to handle an increasing number of users and data.

Accuracy:

Specify the minimum accuracy level that the model should achieve.

Define acceptable error rates or confidence intervals.

Security:

Describe the security measures in place to protect sensitive passenger data.

Specify user authentication and authorization requirements.

Scalability:

Define how the system will handle a growing volume of data and users over time.

Specify any auto-scaling requirements for hosting resources.

Reliability:

Specify the system's uptime requirements.

Define measures for fault tolerance and disaster recovery.

Regulatory Compliance:

Ensure compliance with data protection laws (e.g., GDPR, CCPA) and any industry-specific regulations.

Usability:

Define user interface usability requirements, considering the needs and expectations of the end-users.

Documentation:

Specify the need for comprehensive documentation, including model architecture, data sources, and system operation.

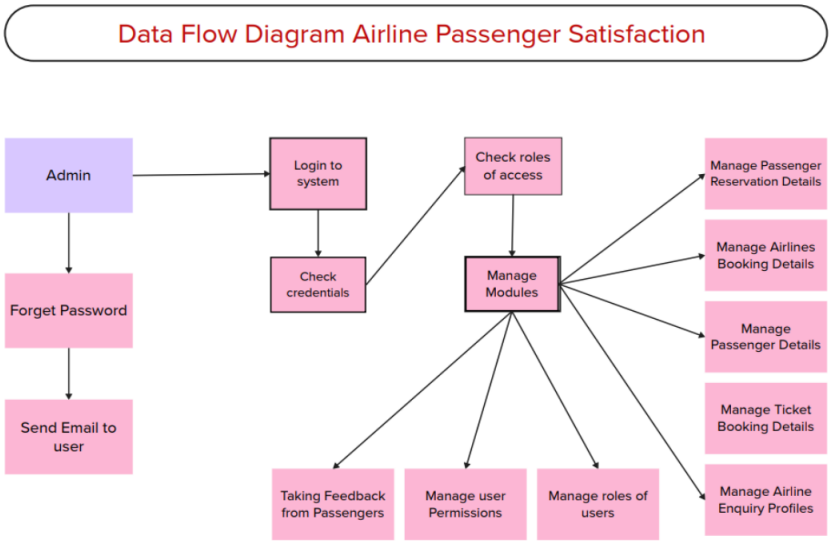
Maintenance and Support:

Define ongoing maintenance and support requirements, including bug fixes, updates, and user support.

5) PROJECT DESIGN

5.1 Data Flow Diagrams & User Stories

Data Flow Diagram

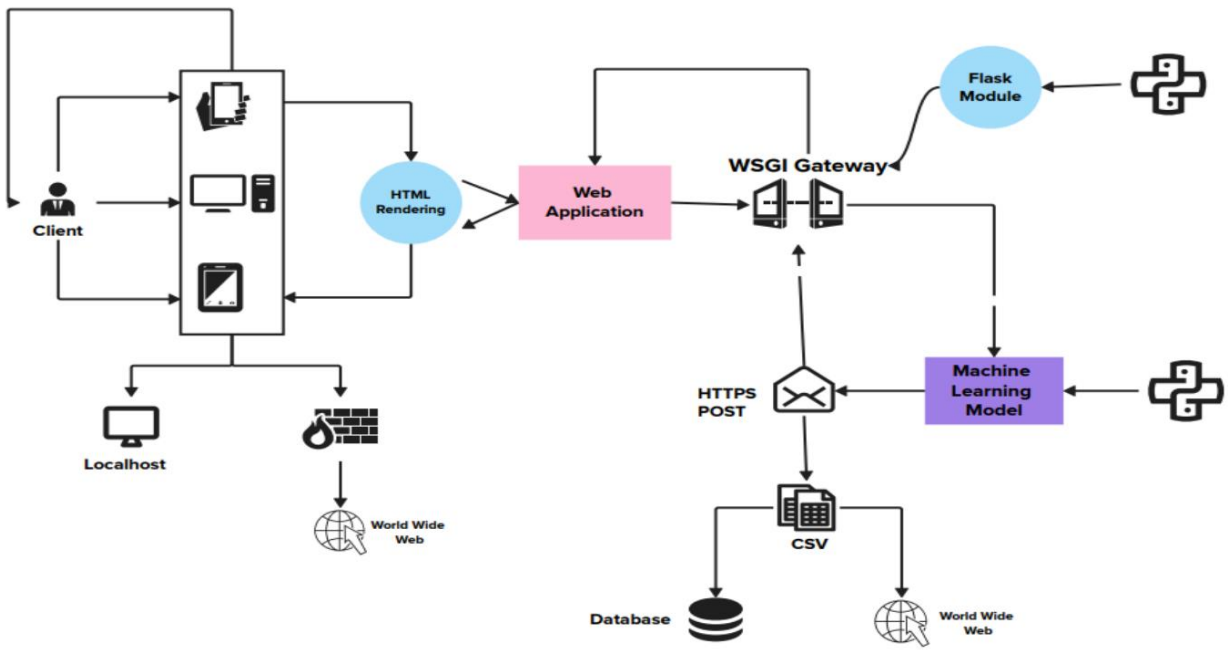


User Stories

User Stories

User Type	Functional requirements (EPIC)	User Story Number	User Story / Task	Acceptance Criteria	Priority	Release
Customer (Mobile User and Web User)	Registration	USN – 1	As a user, I can register for the application by entering my email , password and confirming my password	I can access my account / dashboard	High	Sprint – 1
		USN - 2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN - 3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-3
		USN – 4	As a user, I can register for the application through Gmail	I can register & access the dashboard with Gmail Login	Low	Sprint - 3
	Login	USN – 5	As a user, I can log into the application by entering email & password		High	Sprint - 1
	Submitting Feedback	USN – 6	As a user I can easily submit feedback on my flight experience, including ratings and comments, to help airlines improve their services.	I can access the feedback submission form on the web dashboard, rate various aspects of my flight, provide comments, and submit the feedback. The feedback is recorded and used for analysis.	High	Sprint – 1
	Dashboard (Looking for a proper flight)	USN – 7	As a user, I can look for a flight, based on factors like cabin class, seat comfort, and inflight entertainment.	I can know whether my flight have service which I prioritize more on my flight trip	Medium	Sprint - 2
Customer Care Executive	Passenger Feedback Management	USN – 8	As a customer care executive, I can access a dashboard to manage passenger feedback and respond to complaints.	I can view and categorize passenger feedback, reply to feedback, and track the resolution status.	High	Sprint -1
Administrator	System Administration	USN – 9	As an administrator, I can manage user roles and permissions, configure the machine learning model, and ensure data security and compliance.		High	Sprint - 1

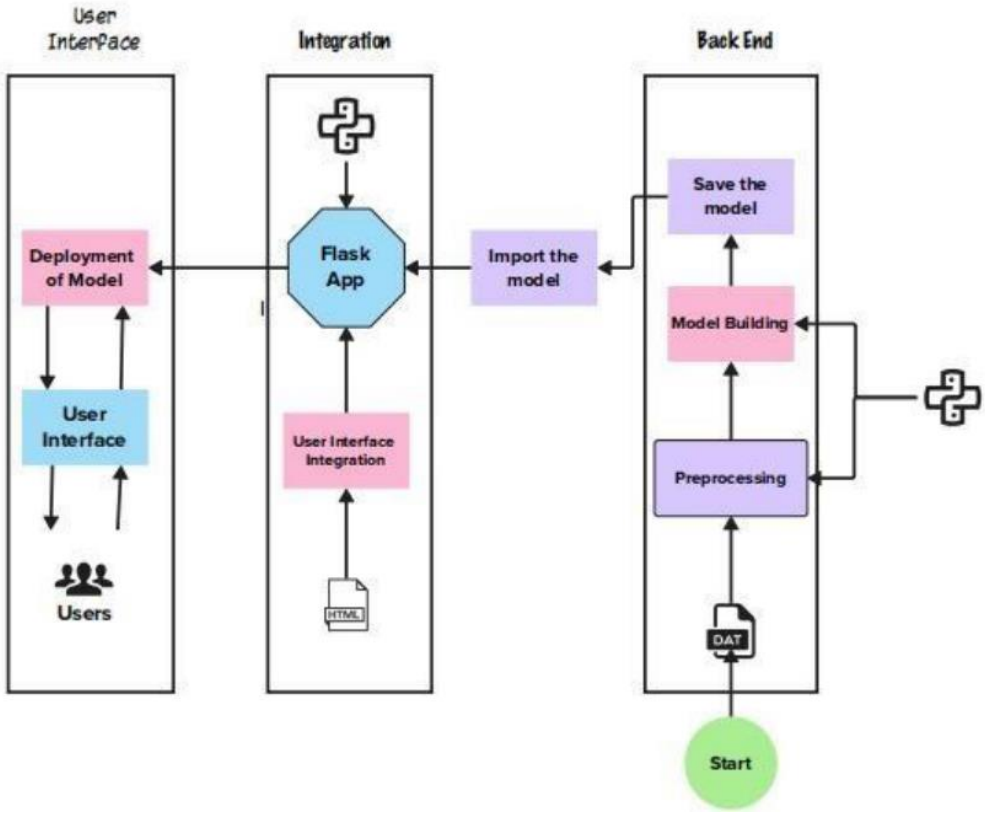
5.2Solution Architecture



6)PROJECT PLANNING & SCHEDULING

6.1Technical Architecture

Technical Architecture:



6.2 Sprint Planning & Estimation

Product Backlog, Sprint Schedule and Estimation (4 Marks)

Sprint	Functional Requirement (Epic)	User Story Number	User Story/Task	Story Points	Priority	Team Members
Sprint - 1	Registration	USN - 1	As a user, I can register for the application by entering my email, password and confirming my password	4	High	3
Sprint – 2		USN - 2	As a user, I will receive confirmation email once I have registered for the application	2	Medium	2
Sprint - 3		USN - 3	As a user, I can register for the application through Facebook	2	Low	1
Sprint - 3		USN - 4	As a user, I can register for the application through Gmail	2	Low	1
Sprint - 2		USN – 4	As a user, I will receive confirmation email once I have registered for the application	2	Medium	2
Sprint - 1	Login	USN - 5	As a user, I can log into the application by entering email & password	4	High	3
Sprint - 2	Submitting Feedback	USN - 6	As a user I can easily submit feedback on my flight experience, including ratings and comments, to help airlines improve their services	4	High	3
Sprint - 1	Dashboard	USN - 7	As a user , I can see the description of the website and informs all the services It offers	4	High	3
Sprint - 3	Dashboard (Looking for a proper flight)	USN - 8	As a user, I can look for a flight, based on factors like cabin class, seat comfort, and inflight entertainment.	2	Medium	2
Sprint - 1	Passenger Feedback Management	USN – 9	As a customer care executive, I can access a dashboard to manage passenger feedback and respond to complaints.	4	High	3
Sprint - 1	Real time data prediction	USN – 10	As an Analyst , I can access the real time data and predict the satisfaction of the passengers. And can also help the airline on what places they need to focus	4	High	3
Sprint - 1	System Administration	USN - 11	As an administrator, I can manage user roles and permissions, configure the machine learning model, and ensure data security and compliance.	4	High	3

6.3 Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date	Story Points Completed (as on Planned End Date)	Sprint Release Date(Actual)
Sprint - 1	24	9 days	25 October 2023	2 November 2023	24	2 November 2023
Sprint - 2	8	4 days	3 November 2023	6 November 2023	8	7 November 2023
Sprint - 3	6	3 days	7 November 2023	9 November 2023	6	9 November 2023

Velocity

$$AV = \frac{sprint\ duration}{velocity}$$

AV = (24 + 8 + 6) / (9 + 4 + 3) = (38 / 16) = 2.375

7) CODING AND SOLUTIONING

a) Replacing Null values and outliers with median

i) Null values replacement

```
df['Arrival Delay in Minutes'].fillna(df['Arrival Delay in Minutes'].median(),inplace = True)
```

ii)Outliers replacement

Making an upper and lower limit using IQR and replacing all the values above

the upper limit and below the lower limit with median of the data

```
q1 = df['Flight Distance'].quantile(0.25)
q3 = df['Flight Distance'].quantile(0.75)
IQR = q3-q1
upper_limit = q3 + 1.5*IQR
lower_limit = q3 - 1.5*IQR
upper_limit,lower_limit
```

```
(3736.5, -250.5)
```

```
df['Flight Distance'] = np.where(df['Flight Distance']>upper_limit,df['Flight Distance'].median(),df['Flight Distance'])
df['Flight Distance'] = np.where(df['Flight Distance']<lower_limit,df['Flight Distance'].median(),df['Flight Distance'])
```

b) Testing all the models and determining the best model using Evaluation metrices

The model which we used to compare are Decision Tree, Random Forest, KNN and Logistic Regression

Out of all models, the Random Forest showed the best performance and is dumped in the Pickle file.

```
#Random Forest Model
def RF(X_train,y_train,X_test,y_test):
  reg4 = RandomForestClassifier(criterion='entropy')
  reg4.fit(X_train, y_train)
  print('Accuracy:')
  print('Training accuracy = ',reg4.score(X_train,y_train))
  print('Test accuracy =',reg4.score(X_test,y_test))
  y_test_pred = reg4.predict(X_test)
  print('Test data confusion matrix')
  print(confusion_matrix(y_test,y_test_pred))
  print('Accuracy Score:',accuracy_score(y_test,y_test_pred))
  print('Test data classification report : ',classification_report(y_test,y_test_pred))
  print('Predicting the data')
```

```
RF(x_train,y_train,x_test,y_test)
```

```
Accuracy:
Training accuracy =  0.9999903757314444
Test accuracy = 0.9585386510625192
Test data confusion matrix
[[14240   333]
 [  744 10659]]
Accuracy Score: 0.9585386510625192
Test data classification report :                precision    recall  f1-score   support

           0       0.95      0.98      0.96     14573
           1       0.97      0.93      0.95     11403

    accuracy                           0.96     25976
   macro avg       0.96      0.96      0.96     25976
weighted avg       0.96      0.96      0.96     25976
```

```
with open("./Airline Passenger.pkl",'wb') as f:
  pickle.dump(reg4,f)
```

c) Using Limits in the inputs of Web Application

To prevent the user to write some abnormal values

for Eg: i) Giving rating for Inflight-service as 10 or -100, so prevent

the model to avoid these extreme values, we are keeping the max as 5 and min as 1

ii) Writing Arrival delay in negative if the Flight arrived early, so the minimum value is set as 0

```
  <label for="Age">Age:</label>
  <input type="number" id="Age" name="Age" min="0" max="120" placeholder="Enter Age">
```

```
    <label for="Flight Distance">Flight Distance:</label>
    <input type="number" id="Flight Distance" name="Flight Distance" min="0" placeholder="Enter Flight

        <label for="Inflight wifi service">Inflight wifi service(1-5):</label>
<input type="number" id="Inflight wifi service" name="Inflight wifi service" min="1" max="5" placehold

<br><br>
```

```
<label for="Gate location">Gate location(1-5):</label>
<input type="number" id="Gate location" name="Gate location" min="1" max="5" placeholder="1-5">

<br><br>

<label for="Food and drink">Food and drink(1-5):</label>
<input type="number" id="Food and drink" name="Food and drink" min="1" max="5" placeholder="1-5">

<br><br>
```

Also providing "Choosing the Option" type option for Categorical Values to avoid a spelling Error while entering the inputs.

```
<form action="/login" method="post">
    <label for="Gender">Gender:</label>
    <select id="Gender" name="Gender">
        <option value="Male">Male</option>
        <option value="Female">Female</option>
    </select>

    <label for="Customer Type">Customer Type:</label>
    <select id="Customer Type" name="Customer Type">
        <option value="Loyal">Loyal Customer</option>
        <option value="disloyal">disloyal Customer</option>
    </select>
```

8) PERFORMANCE TESTING

Evaluating metrics

The model was tested using 4 types of Machine Learning Models

i)Decision Tree

```
dt(x_train,y_train,x_test,y_test)
```

```
accuracy
Training accuracy=  1.0
test accuracy=  0.9389051432091161
Test data confusion matrix:
[[13753   820]
 [  767 10636]]
Test data classification report :
              precision    recall  f1-score   support

           0       0.95      0.94      0.95     14573
           1       0.93      0.93      0.93     11403

    accuracy                           0.94     25976
   macro avg       0.94      0.94      0.94     25976
weighted avg       0.94      0.94      0.94     25976
```

ii) Random Forest Classifier

```
RF(x_train,y_train,x_test,y_test)
```

```
Accuracy:
Training accuracy =  0.9999903757314444
Test accuracy = 0.9585386510625192
Test data confusion matrix
[[14240   333]
 [  744 10659]]
Accuracy Score: 0.9585386510625192
Test data classification report :                precision    recall  f1-score   support

           0       0.95      0.98      0.96     14573
           1       0.97      0.93      0.95     11403

    accuracy                           0.96     25976
   macro avg       0.96      0.96      0.96     25976
weighted avg       0.96      0.96      0.96     25976
```

iii) KNN

```
knn(x_train,y_train,x_test,y_test)
```

```
Accuracy
Training accuracy = 0.8497074222359101
Test accuracy=  0.7663612565445026
Test data confusion matrix:
[[12121  2452]
 [ 3617  7786]]
Test data classification_report :
              precision    recall  f1-score   support

           0       0.77      0.83      0.80     14573
           1       0.76      0.68      0.72     11403

    accuracy                           0.77     25976
   macro avg       0.77      0.76      0.76     25976
weighted avg       0.77      0.77      0.76     25976
```

iv) Logistic Regression

```
lg(x_train,y_train,x_test,y_test)
```

```
accuracy
Training accuracy=  0.8121342777948876
Testing accuracy=  0.809708962118879
Test data confusion matrix:
[[11662  2911]
 [ 2032  9371]]
Test data classification report:
              precision    recall  f1-score   support

           0       0.85      0.80      0.83     14573
           1       0.76      0.82      0.79     11403

    accuracy                           0.81     25976
   macro avg       0.81      0.81      0.81     25976
weighted avg       0.81      0.81      0.81     25976
```

After evaluating the metrices of all the models, we can conclude that the random forest classifier is the best Model for the project

9)RESULT

i) Model Accuracy

```
RF(x_train,y_train,x_test,y_test)
```

```
Accuracy:
Training accuracy =  0.9999903757314444
Test accuracy = 0.9585386510625192
Test data confusion matrix
[[14240   333]
 [  744 10659]]
Accuracy Score: 0.9585386510625192
Test data classification report :                precision    recall  f1-score   support

           0       0.95      0.98      0.96     14573
           1       0.97      0.93      0.95     11403

    accuracy                           0.96     25976
   macro avg       0.96      0.96      0.96     25976
weighted avg       0.96      0.96      0.96     25976

Predicting the data
```

ii) Web page

Airline Satisfaction Prediction

Welcome to the Airline Satisfaction Prediction tool created using Machine Learning.Our prediction tool is designed to help you assess and predict your airline passenger satisfaction based on various factors.

By providing us with essential information such as your gender, age, customer type, and other flight-related details, we can analyze your preferences and expectations. We'll take into account factors like in-flight services, booking experience, seat comfort, and more, to give you an estimate of overall satisfaction with your airline service.

Simply fill out the form on this page with the details, and we'll provide you with a prediction of your airline satisfaction level. This prediction can assist you in making informed decisions when planning future air travel, ensuring that your customer's journey meets your expectations and needs.

Start by entering your information and let us help you predict your airline passenger satisfaction. Let their Journey be comfortable!

Gender:

Female

Customer Type:

Loyal Customer

Age:

44

Type of Travel:

Business Travel

Class:

Business

Flight Distance:

1162

Inflight wifi service(1-5):

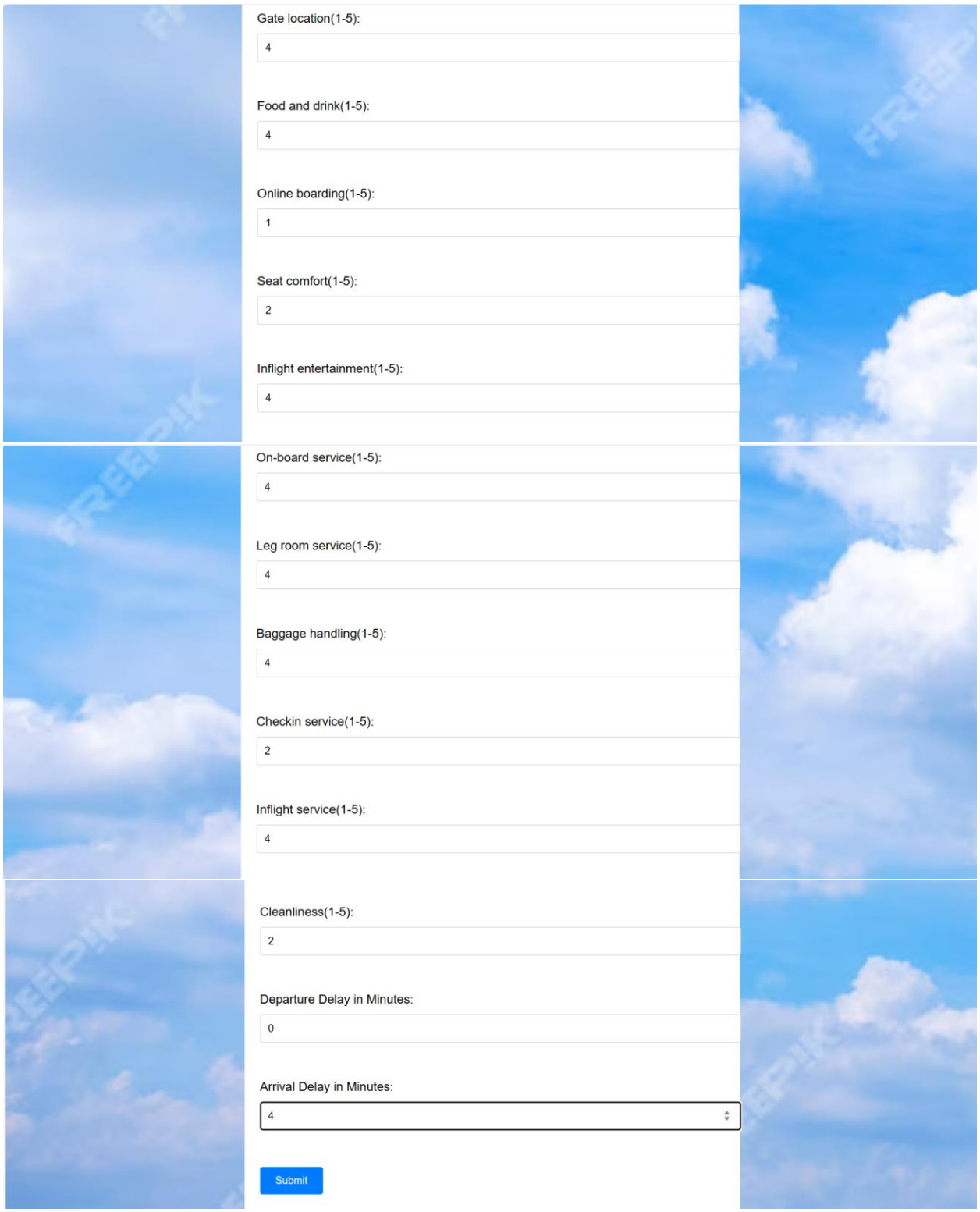
4

Departure/Arrival Time Convenient (1-5):

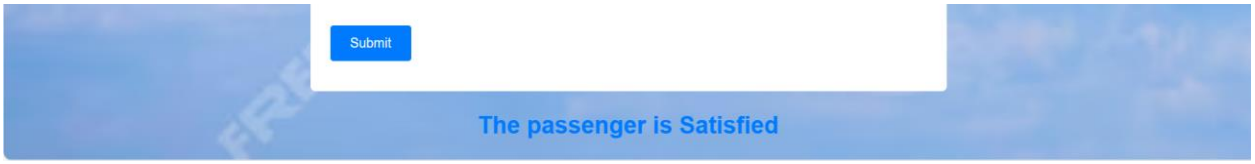
4

Ease of Online booking(1-5):

4



After Pressing the Submit Button



10) ADVANTAGES AND DISADVANTAGES

Advantages

Customer Loyalty:

Advantage: Satisfied passengers are more likely to become loyal customers, choosing the airline for future travel.

Impact: Increased customer retention and repeat business.

Positive Word-of-Mouth:

Advantage: Happy customers often share their positive experiences, leading to good word-of-mouth marketing.

Impact: Potential for attracting new customers based on recommendations.

Competitive Edge:

Advantage: A reputation for high passenger satisfaction can set an airline apart from competitors.

Impact: Increased market share and customer preference.

Financial Performance:

Advantage: Satisfied customers are more likely to spend on additional services, contributing to better financial performance.

Impact: Improved revenue streams and profitability.

Employee Morale:

Advantage: Focusing on passenger satisfaction can enhance employee morale as they contribute to positive customer experiences.

Impact: More motivated and engaged staff, leading to better service.

Customer Feedback for Improvement:

Advantage: Passenger feedback provides valuable insights for identifying and addressing areas of improvement.

Impact: Continuous enhancement of services and operations.

Disadvantages:

Costs of Improvement:

Disadvantage: Implementing changes to enhance passenger satisfaction may involve additional costs.

Impact: Potential strain on the airline's budget.

Unrealistic Expectations:

Disadvantage: Meeting every passenger's expectation can be challenging and may lead to some dissatisfaction.

Impact: Difficulty in achieving perfection, despite best efforts.

Balancing Priorities:

Disadvantage: Focusing solely on passenger satisfaction may divert attention from other critical operational aspects.

Impact: Potential neglect of safety, regulatory compliance, or financial stability.

Subjectivity of Satisfaction:

Disadvantage: Satisfaction is subjective and varies among passengers; what pleases one may not please another.

Impact: Difficulty in universally meeting diverse passenger preferences.

External Factors:

Disadvantage: External factors such as weather or air traffic control issues can impact passenger satisfaction.

Impact: Some factors are beyond the airline's control, affecting the perception of service quality.

Overemphasis on Surveys:

Disadvantage: Relying solely on surveys may not capture the full passenger experience.

Impact: Incomplete understanding of passenger sentiments and potential blind spots in service improvement.

In conclusion, while there are clear advantages to prioritizing passenger satisfaction, there are also challenges and potential drawbacks that need to be carefully managed for a balanced and sustainable approach.

11) CONCLUSION

Prioritizing airline passenger satisfaction is fundamental for the long-term success of an airline. The advantages, including increased customer loyalty, positive word-of-mouth, and a competitive edge, underscore the importance of cultivating a content customer base.

Yet, the complexities of passenger satisfaction demand a nuanced approach. Striking a balance between diverse expectations, operational constraints, and external factors is challenging. Challenges such as unrealistic expectations, subjective perceptions, and factors beyond an airline's control highlight the need for a comprehensive and flexible strategy.

Recognizing the interconnected nature of customer satisfaction with other operational aspects is crucial. Managing costs, leveraging passenger feedback for improvement, and ensuring employee morale are essential components of a well-rounded approach.

In an industry where the customer experience is paramount, an airline's commitment to understanding and surpassing passenger expectations not only enhances the immediate travel experience but also establishes a positive brand image. Ultimately, a thoughtfully executed focus on passenger satisfaction lays the groundwork for sustained success in the competitive aviation landscape.

12) FUTURE SCOPE

A machine learning model designed to predict passenger satisfaction in the airline industry offers a range of opportunities:

1. **Customer-Centric Enhancements**: Airlines can utilize the model to continually enhance their services based on real-time customer feedback, resulting in an improved overall passenger experience.

2. **Tailored Services**: Passengers can benefit from personalized in-flight services and recommendations, making their travel more satisfying and enjoyable.

3. **Competitive Advantage:** Airlines that excel in passenger satisfaction, thanks to the insights provided by the model, can gain a significant edge in the highly competitive aviation market.

4. **Sustainability Integration:** The model can also be applied to assess the environmental impact of services and amenities, assisting airlines in making more eco-conscious decisions.

In summary, the machine learning model has the potential to not only elevate passenger satisfaction but also enhance the competitiveness and sustainability of the airline industry.

13) APPENDIX

Source Code:
(Google Drive Link)

https://drive.google.com/drive/folders/195UIBGnEpVzLjKGBhINXlvCG9-gQX14I?usp=sharing

GitHub Link:
This link will take you to our GitHub where you can see all our phase wise work of our project.

https://github.com/smartinternz02/SI-GuidedProject-598892-1697607131

Project Demo Link (YouTube Link):

https://www.youtube.com/watch?v=1zsLZAUYzfQ&t=4s